



# Intel<sup>®</sup> Itanium<sup>®</sup> 2 Processor

## Specification Update

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*September 2002*

**Notice:** The Intel<sup>®</sup> Itanium<sup>®</sup> 2 processor may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are documented in this specification update.

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## Revision History

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Date	Version	Description
September 2002	003	Added errata 30-37; added PAL version 7.31; added Documentation Change 1; added Specification Clarification 1.
August 2002	002	Added errata 20-29.
July 2002	001	Initial release of this document.

# Preface

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This document is an update to the specifications contained in the Affected Documents/Related Documents table below. This document is a compilation of device and documentation errata, specification clarifications, and changes. It is intended for hardware system manufacturers and software developers of applications, operating systems, or tools.

This document may also contain information that was not previously published.

## Affected Documents/Related Documents

Title	Document #
<i>Intel® Itanium® 2 Processor at 1.0 GHz and 900 MHz Datasheet</i>	250945
<i>Intel® Itanium® 2 Processor Hardware Developer's Manual</i>	251109
<i>Intel® Itanium™ Architecture Software Developer's Manual, Volume 1: Application Architecture</i>	245317
<i>Intel® Itanium™ Architecture Software Developer's Manual, Volume 2: System Architecture</i>	245318
<i>Intel® Itanium™ Architecture Software Developer's Manual, Volume 3: Instruction Set Reference</i>	245319
<i>Intel® Itanium™ Architecture Software Developer's Manual Specification Update</i>	251141
<i>Intel® Itanium®2 Processor Reference Manual for Software Development and Optimization</i>	251110
<i>Itanium™ Processor Family System Abstraction Layer Specification</i>	245359

## Nomenclature

**S-Spec Number** is used to identify products. Products are differentiated by their unique characteristics, e.g. core speed, L3 cache size, package types, etc. Care should be taken to read all notes associated with each S-Spec number.

**Errata** are design defects or errors. These may cause the Intel® Itanium® 2 processor's behavior to deviate from published specifications. Hardware and software designed to be used with any given stepping must assume that all errata documented for that stepping are present on all devices.

**Specification Changes** are modifications to the current published specifications. These changes will be incorporated in the next release of the specifications.

**Specification Clarifications** describe a specification in greater detail or further highlight a specification's impact to a complex design situation. These clarifications will be incorporated in the next release of the specification.

**Documentation Changes** include typos, errors, or omissions from the current published specifications. These changes will be incorporated in the next release of the specifications.

**Note:** Errata remain in the specification update throughout the product's lifecycle, or until a particular stepping is no longer commercially available. Under these circumstances, errata removed from the specification update are archived and available upon request. Specification changes, specification clarifications, and documentation changes are removed from the specification update when the appropriate changes are made to the appropriate product specification or user documentation (datasheets, manuals, etc.).

# Summary Table of Changes

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The following table indicates the errata, specification changes, specification clarifications, or documentation changes which apply to the Itanium 2 processor. Intel may fix some of the errata in a future stepping of the component or in a future release of the Processor Abstraction Layer (PAL), and account for the other outstanding issues through documentation or specification changes as noted. This table uses the notations indicated below.

## Codes Used in Summary Table

### Stepping

X:	Errata exists in the stepping or PAL version indicated. Specification Change or Clarification that applies to this stepping.
(No mark) or (Blank box):	This erratum is fixed in listed stepping or specification change does not apply to listed stepping or PAL version.

### Page

(Page):	Page location of item in this document.
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### Status

Doc:	Document change or update will be implemented.
Plan fix:	This erratum may be fixed in a future stepping of the component, or in a future release of PAL.
Fixed:	This erratum has been previously fixed.
NoFix:	There are no plans to fix this erratum.

### Row



Change bar to left of table row indicates this erratum is either new or modified from the previous version of this document.



## Errata (Sheet 1 of 2)

No.	Processor Stepping	PAL Version		Pg.	Status	Errata
	B3	7.13	7.31			
1	X			13	NoFix	IA64_INST_RETIRED and IA64_TAGGED_INST_RETIRED does not count predicated off instructions
2	X			13	NoFix	Performance Monitor Interrupt raised when freeze bit is written to Performance Monitoring Counter register
3	X			13	NoFix	Priority agent requests with unit mask of I/O not counted
4	X			13	NoFix	Incorrect fault reporting on move to/from the RNAT or BSPSTORE application registers
5	X			14	NoFix	Power good deassertion affects boundary scan testing
6	X			14	NoFix	IA-32: CPUID instruction returns incorrect L3 cache size
7	X			14	NoFix	Performance Monitoring Event counters may be incorrect when using Instruction Address Range checking in fine mode
8	X			15	NoFix	Possible deadlock condition after ptc.g is issued on two-way system
9	X			15	NoFix	EPC, mov ar.pfs and br.ret instructions may combine to yield incorrect privilege level
10	X			16	NoFix	Removal of WAW hazard may lead to undefined result
11	X			16	NoFix	Unexpected data debug, data access or dirty bit fault taken after rfi instruction
12	X			17	NoFix	Incorrect privilege level may be granted if a failed speculation check precedes a privilege level change
13	X			17	NoFix	Floating-point instructions take a floating-point trap before Unimplemented Instruction Address trap
14		X		17	Fixed	PAL_MC_ERROR_INFO does not return an address for certain double bit ECC memory errors
15		X		17	Fixed	PAL_CACHE_READ and PAL_CACHE_WRITE return incorrect status for L1I cache access
16		X		18	Fixed	Unpredictable behavior if the system is awakened from low power mode by an MCA
17		X		18	Fixed	The system may lose an interrupt when SAL_CHECK reads the IVR
18		X		18	Fixed	A bus MCA nested within a recoverable or firmware-corrected bus MCA may not be handled correctly
19		X		18	Fixed	PAL reset sequence performed after a recovery check may result in incorrect system behavior
20		X		19	Fixed	PAL_HALT_LIGHT_SPECIAL provides PAL_HALT functionality
21		X		19	Fixed	PAL_TEST_PROC may access memory with the UC attribute
22		X		19	NoFix	L2 single bit data error promoted to MCA continues to flag a CMCI
23		X		19	Fixed	PAL_TEST_PROC requires specific tests be performed for correct operation
24		X		19	Fixed	PAL_TEST_INFO may return incorrect data for invalid test parameters
25		X		20	Fixed	PAL_CACHE_INIT may not function properly if levels of the cache hierarchy are specified
26		X		20	Fixed	PAL_SET_TIMEOUT may have an unexpected result when timeout = 0
27		X		20	Fixed	Concurrent MCAs that signal a BERR may not set PSP.bc correctly

## Errata (Sheet 2 of 2)

No.	Processor Stepping	PAL Version		Pg.	Status	Errata
	B3	7.13	7.31			
28		X		20	Fixed	PAL_PLATFORM_ADDR may return an error if bit 63 is set
29		X		20	Fixed	PAL_TEST_PROC may overwrite predicate registers
30		X		20	Fixed	Recovery check fails if PAL_B is not found
31		X		21	Fixed	PAL procedure calls may have unexpected results if an incorrect PAL_B version is used
32		X		21	Fixed	Late self-test may have unexpected results during concurrent processor tests
33		X		21	Fixed	PAL_TEST_PROC may cause unexpected system behavior
34		X		21	Fixed	PAL halt procedures may overwrite predicate registers
35	X			22	NoFix	Two resets may be necessary to leave TAP test mode
36	X			22	NoFix	IA-32 instruction pointers may be overwritten under certain boundary conditions
37		X		22	Fixed	Initialization and ETM recovery may overwrite branch register

## Specification Changes

No.	Processor Stepping	PAL Version		Pg.	Status	SPECIFICATION CHANGES
	B3	7.13	7.31			
						None for this revision of this specification update

## Specification Clarifications

No.	Processor Stepping	PAL Version		Pg.	Status	SPECIFICATION CLARIFICATIONS
	B3	7.13	7.31			
1	X			24	Doc	Itanium <sup>®</sup> 2 processor behavior with CMCI to MCA Promotion enabled

## Documentation Changes

No.	Processor Stepping	PAL Version		Pg.	Status	DOCUMENTATION CHANGES
	B3	7.13	7.31			
1	X			25	Doc	Itanium <sup>®</sup> 2 processor I <sub>CTERM</sub> termination agent

# Identification Information

## Intel® Itanium® 2 Package Marking

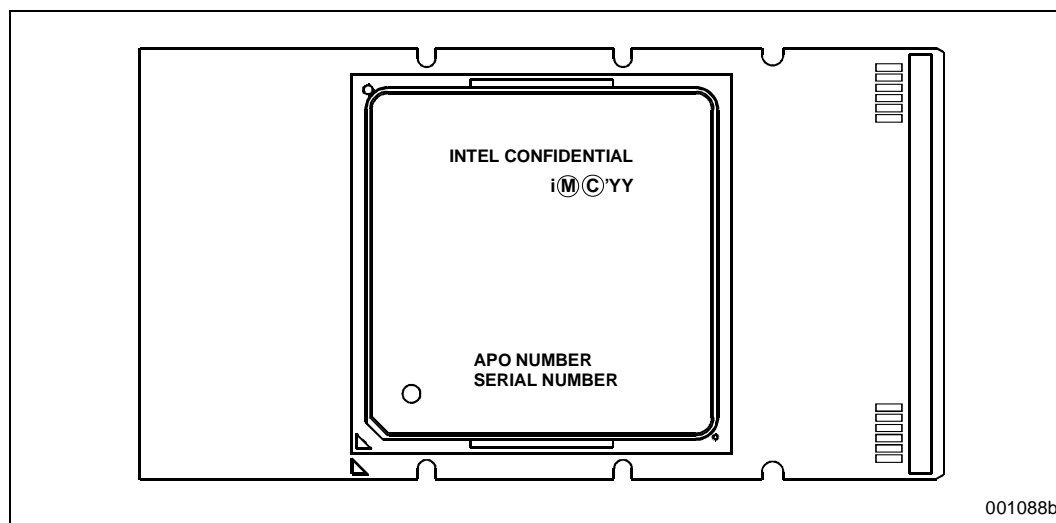
The following section details the processor top-side and bottom-side markings for the Itanium 2 processor and is provided as an identification aid. The processor top-side mark for the product is a laser marking on the Integrated Heat Spreader (IHS).

### Processor Top-Side Marking

Figure 1-1 shows an example of the laser marking on the IHS. The processor top-side mark provides the following information:

- INTEL Brand/ INTEL Product
- Legal Mark
- Assembly Process Order (APO) Number
- Serial Number

Figure 1-1. Processor Top-Side Marking on IHS

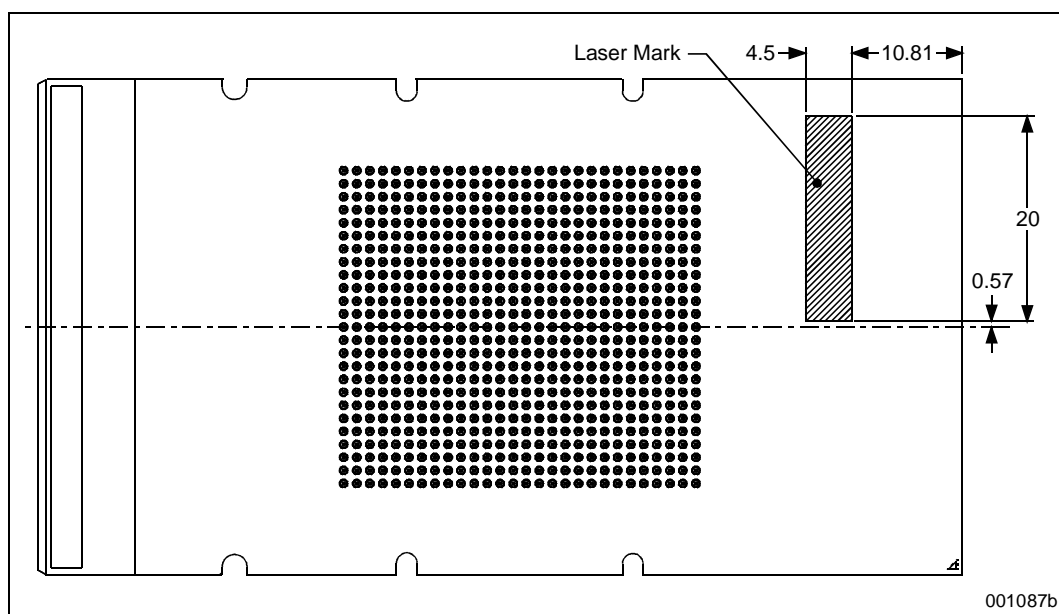


### Processor Bottom-Side Marking

The processor bottom-side mark for the product is a laser marking on the pin side of the interposer. Figure 1-2 shows the placement of the laser marking on the pin side of interposer. The processor bottom-side mark provides the following information:

- Product ID
- Finish Process Order (FPO)
- Serial Number
- S-Spec
- Country of Origin

Figure 1-2. Processor Bottom-Side Marking Placement on Interposer



## Intel® Itanium® 2 Processor Identification and Package Information

S-Spec Number	Processor Stepping	CPUID <sup>1</sup>	Speed (MHz)	L3 Size (Mbytes)
SL67U	B3	001F000704h	1000/400	1.5
SL67V	B3	001F000704h	1000/400	3
SL67W	B3	001F000704h	900/400	1.5
SL6P5	B3	001F000704h	1000/400	1.5
SL6P7	B3	001F000704h	1000/400	3
SL6P6	B3	001F000704h	900/400	1.5

1. The CPUID column in this table indicates the contents of bits 39:0 of CPUID Register 3. Bits 63:40 of this register are reserved. The Family ID for the Itanium 2 processor is 0x1F.

PAL Version	Processor Stepping	Notes
7.13	B3	
7.31	B3	

## Errata

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### 1. **IA64\_INST\_RETIRED and IA64\_TAGGED\_INST\_RETIRED does not count predicated off instructions**

**Problem:** The event monitor count for instructions retired (IA64\_INST\_RETIRED and IA64\_TAGGED\_INST\_RETIRED) does not include the predicated off instructions.

**Implication:** The IA64\_INST\_RETIRED/IA64\_TAGGED\_INST\_RETIRED performance monitoring events may report an incorrect count.

**Workaround:** Add the PREDICATE\_SQUASHED\_RETIRED event monitor count to the IA64\_INST\_RETIRED and/or the IA64\_TAGGED\_INST\_RETIRED event monitor count to get the intended results.

**Status:** For the steppings effected, see the Summary Table of Changes.

### 2. **Performance Monitor Interrupt raised when freeze bit is written to Performance Monitoring Counter register**

**Problem:** The Performance Monitor Freeze (PMC[0].fr) bit within the Performance Monitoring Counter (PMC) register is used to stop performance event monitoring. This can be set by software or by an event counter overflow. Due to this erratum, the processor may raise a Performance Monitor Interrupt (PMI) when the freeze bit is set by software, even when the Performance Monitor Overflow Interrupt (PMC.oi) bit is not enabled and no overflow has occurred.

**Implication:** The processor may generate a PMI when it's not expected to do so.

**Workaround:** The interrupt service routine needs to account for the spurious interrupt even if no performance monitor overflow is indicated.

**Status:** For the steppings effected, see the Summary Table of Changes.

### 3. **Priority agent requests with unit mask of I/O not counted**

**Problem:** The system bus allows for the BPRI# signal to be asserted one cycle before an ADS# is driven by the priority agent, provided no BREQ# pins are driven by the processor. Priority agent requests exhibiting this behavior are not counted by the system bus performance monitoring events when using a unit mask of 'I/O'.

**Implication:** The system bus performance monitoring events may report an incorrect count in this case.

**Workaround:** Measure the bus transactions for all bus masters (unit mask= 'ANY') and subtract from it the sum of the corresponding bus transactions on each local processor (unit mask= 'SELF').

**Status:** For the steppings affected, see the Summary Table of Changes.

### 4. **Incorrect fault reporting on move to/from the RNAT or BSPSTORE application registers**

**Problem:** Incorrect faulting behavior may be experienced under the following conditions:

1. A `mov . imm` (move immediate) to the `ar.rsc` register is executed in the same instruction bundle (or the next bundle with no intervening stop bits) as a mispredicted branch.
2. The mispredicted branch path includes another `mov . imm` to the same `ar.rsc` register, and is within two issue groups or less of the (mispredicted) branch instruction. This instruction is not executed. Also, the value moved to the `rsc.mode` field must be different than the value moved to `rsc.mode` in the `mov . imm` in step 1.

3. The correct branch path is then taken and includes a move to/from the ar.rnat or ar.bspstore registers, within the first bundle (or second bundle with no intervening stop bit) of the correct branch instruction.

**Implication:** When the above conditions line up (and there are no stalls or cache misses), the instruction in step 3 (move to/from ar.rnat or ar.bsp) uses the rse.mode value from the mov.imm in the mispredicted branch path instead of from instruction in step 1. As a result, there may be incorrect faulting behavior – an illegal opcode fault is missed (if rse.mode != 0) or falsely indicated (if rse.mode = 0) and may result in inconsistent system behavior. This erratum has only been observed in a system validation environment.

**Workaround:** Use one of the following workarounds:

1. Use the register form of the move instruction or;
2. Ensure there is a stop bit between any mov.imm instruction to/from the ar.rsc registers and any subsequent branch instruction or;
3. Ensure that there is a stop bit between a “label” (branch target) and a subsequent move to/from ar.rnat/ar.bspstore.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 5. Power good deassertion affects boundary scan testing

**Problem:** Deassertion of the PWRGOOD signal during boundary scan testing prevents the correct operation of the sampling functionality in the EXTEST and SAMPLE/PRELOAD JTAG commands.

**Implication:** As a result of this erratum the boundary scan chain function is disabled and will stop shifting data when the PWRGOOD signal is low.

**Workaround:** Keep the PWRGOOD signal asserted during boundary scan testing.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 6. IA-32: CPUID instruction returns incorrect L3 cache size

**Problem:** The IA-32 CPUID instruction will always report the L3 cache size as 3 MB even for processors with a cache size of 1.5 MB.

**Implication:** IA-32 applications using the IA-32: CPUID instruction cannot rely on the cache size reported by this instruction. Native Itanium applications are not affected by this erratum and can access this information via the processor CPUID registers.

**Workaround:** Within the Linux\* operating system (OS) environment, the '/proc/cpuinfo' file contains this information. Within the Microsoft\* OS environment this information is available through Windows API calls.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 7. Performance Monitoring Event counters may be incorrect when using Instruction Address Range checking in fine mode

**Problem:** For Performance Monitoring Events that use Instruction Address Range Matching set to 'Fine Mode' (PMC: 14, bit 13 = 1), the address matching capability will be inconsistent and may yield incorrect results.

**Implication:** Due to this erratum the results of an event counter while using 'Fine Mode' may not be correct.

**Workaround:** Use normal mode when using Instruction Address Range checking.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 8. Possible deadlock condition after `ptc.g` is issued on two-way system

**Problem:** In a two processor system, a `ptc.g` instruction is issued on processor A. The execution of the `ptc.g` on processor A, blocks the completion of a semaphore upon which processor B is waiting to become available. Concurrently processor B is issuing a long series of loads and stores with one or more instructions being retried or involves system memory access before being retired. Processor B's L2 cache entry queue, denoted as OzQ, is full and does not allow the `ptc.g` operation from processor A, entry into the L2 OzQ for completion. The `ptc.g` request will be presented again in three clock cycles. If processor B continues to execute a code sequence such that the L2 cache OzQ entries continue to be taken by other load/stores, then the `ptc.g` operation must continue to wait.

**Implication:** Due to this erratum, the system may deadlock while waiting for the `ptc.g` to be completed. Any break in, or completion of the code loop on processor B, including system interrupts, that allows the `ptc.g` operation to enter the L2 cache OzQ on processor B will be enough to release the deadlock condition. Additional processors will also change the time cycle necessary for this event to occur. This issue has only been observed during Random Instruction Testing in a system validation environment.

**Workaround:** None at this time.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 9. EPC, `mov ar.pfs` and `br.ret` instructions may combine to yield incorrect privilege level

**Problem:** Due to certain internal timing and microarchitectural conditions, OS calls that return to user space from privilege code promote pages using a `br.ret` instruction, may not have the expected privilege level.

Using the following code sequence as an example:

```
<change of privilege level>    //epc on promote page; or br.ret
mov ar.pfs, [value];           //new pfs value has ppl < cpl
br.ret;;
```

In this case the `br.ret` is specified to not change the privilege level (`p1`) since the `br.ret` is asking to promote privilege to a numerically lower level. Current processor steppings may change current privilege level (`cpl`) to the `p1` at the beginning of the `<change of privilege level>`.

**Implication:** This erratum would result in having the `cpl` demoted and the user space application may not receive the correct privilege level. Privilege code promote page usage is limited and controlled by the OS. This issue has only been observed during random instruction testing in a system validation environment.

**Workaround:** Use one of the following workarounds:

1. Use an return from interrupt (`rfi`) instruction instead of `br.ret` to return from privilege code promote pages.
2. Insert a useless call-to-next bundle in all paths leading to a demoting `br.ret`.
3. PAL version 7.01 and above, have a workaround for this issue and it is enabled by default. The OS may implement one of the previous workarounds or a check mechanism, such that this PAL workaround can be disabled. Please review the PAL Release notes for details on the implementation of this workaround.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 10. Removal of WAW hazard may lead to undefined result

**Problem:** Due to internal conditions an allowed WAW dependency may become a WAW hazard under the following circumstances:

- A move to the AR.PFS register is followed by a BR.CALL and both are executed in the same issue group, or
- A move to the AR.EC register is followed by a BR.RET and both are executed in the same issue group.

These combinations of instructions are legal WAW memory dependencies if one of the operations is predicated off. If preceding instructions (as indicated above) combine to change the predication on the BR.CALL or BR.RET from predicated true to predicated false, the processor may mistakenly decide the WAW hazard is still present and fail to recognize that the WAW has been removed which may result in an undefined value for ar.pfs or ar.ec.

The following code sequence demonstrates this issue:

```
p15 = 1;
;;
mov ar.pfs = R[x];
ld.c R[y] = [m]; //causes R[y] to be reloaded.
cmp.eq p15, p16 = R[y], R0;
(p15) br.call;
```

The RAW dependencies on ld.c to cmp and cmp to branch are legal. When the processor executes the issue group, the WAW hazard is present and the PFS results are undefined. If the ld.c misses the advanced load address table (ALAT), the cmp to branch will be re-executed, the new result of the ld.c causes the p15 value to change to false and thus eliminate the WAW. Then the processor may fail to recognize that the WAW has been removed.

**Implication:** An application may hang or signal an exception fault under these circumstances. The affected code sequence is not known by Intel to be generated in any current compiled code or exist in any current OS.

**Workaround:** Separate the predicate producing instruction from its consumer with a stop (as recommended in the *Intel® Itanium™ Architecture Software Developer's Manual*, Volume 1: Application Architecture) or change the predication sequence to assure mutually exclusive predication of the instructions in the WAW dependency.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 11. Unexpected data debug, data access or dirty bit fault taken after rfi instruction

**Problem:** A fault may be taken after a rfi instruction has been executed under the following circumstances. The IPSR.da or IPSR.dd bits are set to disable data debug/data access/dirty bit faults for the first Itanium processor system environment restore instruction. This is followed by an rfi instruction. The rfi instruction is followed by additional instructions that generate register stack engine (RSE) activity (alloc, flushrs, br.ret). The processor will see the RSE activity as valid Itanium system instructions and clear the ipsr.da/dd bits and this may result in an unexpected data debug, data access or dirty bit fault at the target of the rfi.

**Implication:** Due to this erratum an unexpected fault may be generated after an rfi instruction has been executed. This may slow the transition of the system into the Itanium system environment and log un-necessary errors.

**Workaround:** Separate the rfi from the RSE generating instruction by four issue groups of nop instructions.

**Status:** For the steppings affected, see the Summary Table of Changes.



## 12. **Incorrect privilege level may be granted if a failed speculation check precedes a privilege level change**

**Problem:** A failed speculation check instruction (`chk.s/chk.a/fchkf`) that is followed by a privilege change operation may result with the incorrect privilege level for instructions in the issue group of the privilege level change and beyond. The privilege changing instruction must occur within two clock cycles of the failed speculation check.

**Implication:** As a result of this erratum, the speculation check recovery code and subsequent instructions may have an incorrect privilege level.

**Workaround:** Do not use speculation near privilege changing instructions. The workaround for this erratum is to escalate failed speculation checks (speculation check re-steers) to the OS for recovery. This workaround is included in PAL version 7.01 and above.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 13. **Floating-point instructions take a floating-point trap before Unimplemented Instruction Address trap**

**Problem:** A floating-point instruction that causes a floating-point trap and is the last instruction at the top of the physical address space should flag an Unimplemented Address trap before the floating-point trap.

**Implication:** The correct trap is flagged but only after the floating-point trap is taken first.

**Workaround:** None at this time.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 14. **PAL\_MC\_ERROR\_INFO does not return an address for certain double bit ECC memory errors**

**Problem:** `PAL_MC_ERROR_INFO` will report the address for the source of a double bit ECC memory error. However, under the conditions that the data with a 2xECC error was prefetched to the L2 cache and later filled into the L1 cache, the source address will not be available.

**Implication:** `PAL_MC_ERROR_INFO` will not be able to report the address of a double bit ECC error in this case. Double bit errors that are consumed in this scenario will be not be recoverable.

**Workaround:** None at this time.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 15. **PAL\_CACHE\_READ and PAL\_CACHE\_WRITE return incorrect status for L1I cache access**

**Problem:** The `PAL_CACHE_READ` and `PAL_CACHE_WRITE` procedures should return a status value of ‘-7’ (which indicates this operation is not supported for this *cache\_type* and *level*) when attempting to read or write to/from the L1I (instruction) and L1D (data) cache. When these procedures attempt to access the L1I cache an incorrect status value will be returned.

**Implication:** Due to this erratum, using these PAL procedures to access the L1I cache will result in the return of an incorrect status value, implying that the L1I cache is readable/writable by these PAL procedure calls.

**Workaround:** Do not use these PAL procedures to access the L1D and L1I caches.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 16. Unpredictable behavior if the system is awakened from low power mode by an MCA

**Problem:** If the system is in low power mode and an machine check abort (MCA), BERR# or BINIT# is signaled, the PALE\_CHECK handler will be called to process the error condition. However, PALE\_CHECK does not disable low power mode so that it can continue execution. As soon as PALE\_CHECK attempts to drain the processor queues, the system may re-enter low power mode. This may cause incomplete handling of the error event and potentially, intermittent continuation of the same event during later signaled BINIT# events.

**Implication:** The processor can appear to be trapped in low power mode and/or system behavior may be unpredictable.

**Workaround:** Do not use low power mode or call the following PAL procedures: PAL\_HALT, PAL\_HALT\_LIGHT or PAL\_HALT\_LIGHT\_SPECIAL.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 17. The system may lose an interrupt when SAL\_CHECK reads the IVR

**Problem:** The PAL\_REGISTER\_INFO procedure returns an incorrect value to indicate that reading the Interrupt Vector Register (IVR), CR65 (Configuration Register 65) has no side effects. Based on this incorrect return value, when SAL\_CHECK reads the IVR while saving system state data to NVRAM, a pending interrupt may be allowed to proceed before the current process has been completed.

**Implication:** The SAL\_CHECK procedure relies on the return values of PAL\_REGISTER\_INFO to know which ARs and CRs are safe to read and save off. Due to this erratum, the SAL\_CHECK reads the IVR, and consequently causes the corresponding bit in the IRR to be cleared and the ISR to change. The results of the interrupt routine currently being executed may be lost.

**Workaround:** After calling PAL\_REGISTER\_INFO with *info\_request* = 3, System Abstraction Layer (SAL) can force the correct return value for CR65 by setting bit 1 of *reg\_info\_2* to a value of one.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 18. A bus MCA nested within a recoverable or firmware-corrected bus MCA may not be handled correctly

**Problem:** During the processing of a non-fatal bus MCA, if a second bus MCA is received the second MCA may be missed.

**Implication:** A bus MCA received in this scenario may be missed and result in unpredictable system behavior. If the first MCA is fatal, system behavior remains correct.

**Workaround:** None at this time.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 19. PAL reset sequence performed after a recovery check may result in incorrect system behavior

**Problem:** The PAL early self-test sequence performed after a recovery check may not properly serialize outstanding memory transactions.

**Implication:** As a result of this erratum, memory transactions that are outstanding at the point of transition from the recovery check handler to PAL may cause a deadlock condition and possibly hang the processor.

**Workaround:** SAL can call the PAL\_MC\_DRAIN procedure before returning to PAL from recovery check to ensure that outstanding transactions have completed.

**Status:** For the steppings affected, see the Summary Table of Changes.

**20. PAL\_HALT\_LIGHT\_SPECIAL provides PAL\_HALT functionality**

**Problem:** The PAL\_HALT\_LIGHT\_SPECIAL procedure does not issue the stop grant acknowledge special bus cycle.

**Implication:** PAL\_HALT\_LIGHT\_SPECIAL behavior will be the same as PAL\_HALT.

**Workaround:** None at this time.

**Status:** For the steppings affected, see the Summary Table of Changes.

**21. PAL\_TEST\_PROC may access memory with the UC attribute**

**Problem:** The 'mem\_attr' self-test in PAL\_TEST\_PROC may access memory with the UC attribute, even though the 'attributes' parameter does not allow UC access.

**Implication:** PAL\_TEST\_PROC may access uncacheable memory that may not be supported in some systems.

**Workaround:** Set bit 44 of the PAL\_TEST\_PROC procedure self-test control word (*st\_control*) to '1' to skip the 'mem\_attr' self-test.

**Status:** For the steppings affected, see the Summary Table of Changes.

**22. L2 single bit data error promoted to MCA continues to flag a CMCI**

**Problem:** With correctable machine check interrupt (CMCI) to MCA promotion enabled and an L2 single bit ECC data error occurs, an MCA is signaled but the CMCI continues to be raised. After the MCA is completed and the system calls the PAL\_MC\_RESUME procedure, a CMCI is raised if *PSR.i* = 1 (respond to external interrupts) and the *CMCV.m* = 0 (CMCI interrupts are pended).

**Implication:** A CMCI continues to be signaled on L2 1x ECC data errors, even if CMCI to MCA promotion is enabled.

**Workaround:** When enabling CMCI to MCA promotion, mask CMCI by saving the state of *CMCV.m* then set *CMCV.m* = '1'. Restore the original state of *CMCV.m* when disabling promotion.

**Status:** For the steppings affected, see the Summary Table of Changes.

**23. PAL\_TEST\_PROC requires specific tests be performed for correct operation**

**Problem:** PAL\_TEST\_PROC self-test requires three specific tests be performed, otherwise the PAL procedure may report false failures or unexpected behavior.

**Implication:** The PAL\_TEST\_PROC procedure must perform the virtual hash page table (VHPT) test (bit 34), late floating-point test (bit 41) and RSE test (bit 45). Otherwise the system may have unexpected behavior or false test failures may be indicated.

**Workaround:** Bits 34, 41 and 45 in the PAL\_TEST\_PROC self-test control word (*st\_control*) should be left at the default settings of '0' so these tests are performed.

**Status:** For the steppings affected, see the Summary Table of Changes.

**24. PAL\_TEST\_INFO may return incorrect data for invalid test parameters**

**Problem:** The PAL\_TEST\_INFO procedure may return incorrect data or status if the input arguments are not valid or are out of range for a given parameter.

**Implication:** Calling the PAL\_TEST\_PROC procedure with invalid inputs may result in incorrect data and/or status instead of indicating invalid arguments.

**Workaround:** Ensure that PAL\_TEST\_INFO input parameters are valid and within the argument's range.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 25. **PAL\_CACHE\_INIT may not function properly if levels of the cache hierarchy are specified**

**Problem:** PAL\_CACHE\_INIT does not function properly when caches are selected individually.

**Implication:** A call to initialize the L1D cache may hang the processor and a call to initialize any other cache structure may fail and return an error.

**Workaround:** Call the PAL\_CACHE\_INIT procedure with level = -1 to initialize all caches.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 26. **PAL\_SET\_TIMEOUT may have an unexpected result when timeout = 0**

**Problem:** Setting the input parameter timeout = 0 will disable the processor watchdog timer feature.

**Implication:** Calling PAL\_SET\_TIMEOUT with timeout = 0 disables the internal processor timeout function.

**Workaround:** Do not set the timeout parameter to '0'.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 27. **Concurrent MCAs that signal a BERR may not set PSP.bc correctly**

**Problem:** In the case of concurrent MCAs that should result in BERR assertion, the PALE\_CHECK handler may not set the PSP.bc (bus check error) bit before handing off to SAL.

**Implication:** As a result of this erratum, PAL\_MC\_ERROR\_INFO will indicate that a bus error occurred, but the PSP at hand-off to SAL\_CHECK will not.

**Workaround:** None at this time.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 28. **PAL\_PLATFORM\_ADDR may return an error if bit 63 is set**

**Problem:** PAL\_PLATFORM\_ADDR should ignore bit 63 of the *address* argument. If this PAL procedure is called with bit 63 set to '1' in the *address* argument, the procedure incorrectly returns status = -2 (invalid argument).

**Implication:** Due to this erratum, calling PAL\_PLATFORM\_ADDR with bit 63 of the address set to '1' will return a status of 'invalid argument'.

**Workaround:** Bit 63 should be set to '0' when calling the PAL\_PLATFORM\_ADDR procedure to avoid this issue.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 29. **PAL\_TEST\_PROC may overwrite predicate registers**

**Problem:** PAL\_TEST\_PROC may overwrite predicate registers pr4 and pr5, which should be preserved by the procedure.

**Implication:** PAL\_TEST\_PROC may modify pr4 or pr5, resulting in undefined behavior.

**Workaround:** Code calling this PAL procedure can save and restore these predicate registers around the PAL\_TEST\_PROC procedure.

**Status:** For the steppings affected, see the Summary Table of Changes.

## 30. **Recovery check fails if PAL\_B is not found**

**Problem:** SAL may not be able to complete a recovery check when no PAL\_B is present. The I/O port address, interrupt block and other features may not be available for SAL when recovery check is entered from PAL\_A\_SPEC.

**Implication:** Recovery check may fail if PAL\_B is not available or is invalid.

**Workaround:** Ensure that the firmware interface table (FIT) entry for PAL\_B points to a valid and correct version of PAL\_B.

**Status:** For the steppings affected, see the Summary Table of Changes.

### **31. PAL procedure calls may have unexpected results if an incorrect PAL\_B version is used**

**Problem:** PAL procedures that call PAL\_B may not provide the expected results if the first PAL\_B entry in the FIT points to an incorrect version of PAL\_B.

**Implication:** PAL procedures may fail if the PAL\_B entry in the FIT is for an incorrect version.

**Workaround:** Ensure that the FIT entry for PAL\_B points to the correct version.

**Status:** For the steppings affected, see the Summary Table of Changes.

### **32. Late self-test may have unexpected results during concurrent processor tests**

**Problem:** While running PAL\_TEST\_PROC concurrently on more than one processor and the processors happen to access the same memory address space, a snoop may cause the ALAT test to fail.

**Implication:** If a processor self-test procedure is using the same memory space for concurrent processor testing, the ALAT test may fail and cause one processor to enter a spin loop.

**Workaround:** The ALAT test can be bypassed by setting bit 46 of the PAL\_TEST\_PROC self-test control word to '1'.

**Status:** For the steppings affected, see the Summary Table of Changes.

### **33. PAL\_TEST\_PROC may cause unexpected system behavior**

**Problem:** The PAL\_TEST\_PROC 'late floating-point load/store test' may overwrite the fr2-fr5 and fr30-fr31 floating-point registers and the Bank 0 gr16-gr23 general registers may be overwritten by the ALAT, VHPT, translation lookaside buffer (TLB) and memory attributes tests.

**Implication:** PAL\_TEST\_PROC may corrupt the following registers: Bank 0 gr16-gr23 (general registers) and the fr2-fr5, fr30-fr31 (floating-point registers).

**Workaround:** Use different registers or save/restore the contents before/after running PAL\_TEST\_PROC.

Using the self-test control word of the PAL\_TEST\_PROC procedure, set the following bits to '1': To avoid corrupting the Bank 0 general registers do not run the ALAT (bit 46), VHPT (bit 35), TLB (bit 33) and mem\_attr (bit 44) tests. To avoid corrupting the floating-point registers do not run the late\_fp\_ld\_st (bit 40) test.

**Status:** For the steppings affected, see the Summary Table of Changes.

### **34. PAL halt procedures may overwrite predicate registers**

**Problem:** Predicate registers pr1, pr2 and pr3 may be overwritten by the PAL\_HALT, PAL\_HALT\_LIGHT and PAL\_HALT\_LIGHT\_SPECIAL procedures.

**Implication:** As a result of this erratum, pr1, pr2 and pr3 may be overwritten.

**Workaround:** Save and restore the predicate registers, as needed when calling these PAL procedures.

**Status:** For the steppings affected, see the Summary Table of Changes.

**35. Two resets may be necessary to leave TAP test mode**

**Problem:** After accessing the test access port (TAP), issuing a RESET# may result in the processor entering an idle state instead of beginning normal operation. Signaling a second RESET# may be necessary to properly reinitialize the system under these conditions.

**Implication:** Due to this erratum, a second RESET# may be required to properly reinitialize the processor after the TAP port has been accessed. Normal system operation and boot process is not affected.

**Workaround:** Issue two resets to properly reinitialize the processor after accessing the TAP port.

**Status:** For the steppings affected, see the Summary Table of Changes.

**36. IA-32 instruction pointers may be overwritten under certain boundary conditions**

**Problem:** Under certain internal conditions involving branch prediction and multiple branch instructions, IA-32 instruction pointers may be overwritten and result in IA-32 instructions being executed out of order or incorrectly. An affected code sequence would have consecutive branch instructions that have started execution before being cancelled.

**Implication:** Due to this erratum, IA-32 instruction pointers may be over-written resulting in incorrect IA-32 instruction execution.

**Workaround:** A workaround for this erratum is included in PAL version 7.31.

**Status:** For the steppings affected, see the Summary Table of Changes.

**37. Initialization and ETM recovery may overwrite branch register**

**Problem:** PAL INIT recovery code may overwrite br0, when it saves the system environment to the min-state save area. This erratum also affects the recovery path of an enhanced thermal management (ETM) alert that is generated while a system is in a low power mode.

**Implication:** INIT and ETM recovery code may overwrite br0, which prevents recovery with PAL\_MC\_RESUME and may result in unexpected system behavior.

**Workaround:** PAL version 7.31 fixes this issue.

**Status:** For the steppings affected, see the Summary Table of Changes.



## **Specification Changes**

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There are no Specification Changes for this revision of the *Intel® Itanium® 2 Processor Specification Update*.

# Specification Clarifications

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## 1. Itanium® 2 processor behavior with CMCI to MCA Promotion enabled

The *Itanium® 2-Based Platform Compatible Processors Firmware Guide* (Document Number 12042), Section 4.7.1.1 describes known behavior on the Itanium 2 processor with regard to CMCI to MCA Promotion and should be further clarified as follows:

- On the Itanium 2 processor, if a concurrent frontside bus (FSB) and L3 cache errors occur, PAL will not recognize the FSB error. The only events that may be ignored are UC accesses that get a HITM or FSB transactions that get a hardfail response. The UC HITM case is a manifestation of illegal memory aliasing attribute (MAA) and should not be common. For hardfail responses, an MCA is generated when the poisoned data is consumed so there is no silent data corruption possibility.



# Documentation Change

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## 1. Itanium® 2 processor I<sub>CTERM</sub> termination agent

The following correction will be made to the next revision of the *Intel® Itanium® 2 Processor at 1.0 GHz and 900 MHz Datasheet* (Document Number 250945).

- In Section 2.3, Table 2-2 “Itanium® 2 Processor Package Specification”, footnote c. associated with I<sub>CTERM</sub> is stated incorrectly:
  - The original text read:  
Maximum termination voltage current on **two** termination agents.
  - The correct text should read:  
Maximum termination voltage current on **one** termination agent.

